ERGONOMICS DEMONSTRATION PROJECT

Utilities

December, 2002

Department of LABOR AND INDUSTRIES

INTRODUCTION TO UTILITIES DEMONSTRATION PROJECT:

The utility industry is very aware that utility workers experience many serious work-related musculoskeletal disorders (WMSDs), particularly affecting the back and shoulders. In1999, four people from several electric utility companies started informal quarterly meetings to discuss common ergonomic issues and ideas to address common problems. Rather than each company having to independently think of ways to solve problems, a group effort seemed to be a wiser approach. They saw the benefits of learning from one another--sharing things each utility had tried, what worked well, and what did not.

Word spread and interest in the group rapidly grew, expanding membership to over fifteen western utility companies from five states and British Columbia. The group began calling itself the Western Utilities Ergonomics Group (WUEG). WUEG membership grew to include health and safety personnel from electric, gas, water, and sewer utilities.

Since Washington State adopted the ergonomics rule, it prompted the WUEG to learn about the rule and figure out how to apply it to their workforce. WUEG realized the need to do job analyses to identify caution zone jobs and hazard zone jobs. Despite membership outside Washington, the group the group agreed to work together to address the Washington rule. WUEG asked to be involved in a demonstration project. The demonstration project began in April 2001.

The group was highly concerned about how to assess jobs with high task variability. The project used a two-prong approach. One part was to encourage appropriate use of the caution zone job/hazard zone job checklist methods for many jobs. The second part was to develop an assessment method intended for more difficult jobs.

The full demonstration project will be presented in several sections.

1. **Job Assessments**
2. **Manhole Cover Removal**
3. **Component Method**

JOB ASSESSMENTS

Members of the Western Utilities Ergonomics Group (WUEG) completed 13 assessments of common utility jobs. These assessments came from 8 utility companies including water, gas, sewer, and electric utility companies. All caution zone job assessments were completed using a checklist approach except the lineworker job. Each job was evaluated to see if it met any caution zone criteria. A Hazard level assessment was completed for each noted caution zone job. Hazard zone jobs are listed as HZJs. All identified hazards were due to heavy lifting. (See next page prior to viewing individual job assessments). Click job title to view full assessment. Solution examples are provided for identified hazards.

Summary Results of Job Assessments:

Job Title	Type of Utility	Employer	Assessment Result
1. Meter Reader	Water	City of Everett	No CZJ
2. Supervisor	Water	City of Everett	No CZJ
3. Meterman	Electric	Clark Public Utilities	No CZJ
4. Lab Assistant	Water	Seattle Public Utilities	CZJ, No HZJ
5. Microbiologist	Water	Seattle Public Utilities	CZJ, No HZJ
6. Chemist	Water	Seattle Public Utilities	CZJ, No HZJ
7. Utility Electrician	Electric	Mason County PUD	CZJ, No HZJ
8. Customer Field Service Technician	Gas	Puget Sound Energy (gas and electric)	CZJ, No HZJ
9. Wire Room – Wireman	Electric	Seattle City Light	HZJ
10. Lineworker	Electric	Composite assessment from multiple utilities	HZJ
11. Vactor truck operator	Water	Woodinville Water District	HZJ
12. Gas Fitter	Gas	Puget Sound Energy	HZJ
13. Maintenance Worker 2	Sewer	City of Vancouver, WA	HZJ

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this table reflect the job at a particular utility company. The results may not be true for the same job title at a different utility depending on the mix of job duties per company. Companies are responsible to verify their own results.

*** Only Abbreviated descriptions from column 2 will be used in each job assessment*

Full Description of Caution Zone Jobs	Abbreviated Descriptions of Caution Zone Jobs
1. Hands above the head, or elbow(s) above the shoulder for more than 2 hrs. per day	1. Hand(s) overhead
2. Neck or bent back > 30° for more than 2 hrs. per day (without support and without the ability to vary posture	2. Neck bent > 30° or back bent > 30°
3. Squatting for more than 2 hrs. per day	3. Squatting
4. Kneeling for more than 2 hrs. per day	4. Kneeling
5. Pinching an unsupported object(s) weighing > 2 lbs. per hand, or pinching with a force of > 4 lbs. per hand, for more than 2 hrs. per day (comparable to pinching half a ream of paper)	5. Pinching > 2 lbs. or > 4 lbs. of force
6. Gripping an unsupported object(s) weighing > 10 lbs. per hand, or gripping with a force > 10 lbs. per hand for more than 2 hrs. per day (comparable to clamping light duty automobile jumper cables onto a battery)	6. Gripping > 10 lbs. or > 10 lbs. of force
7. Repeating the same motion with the neck, shoulders, elbows, wrists, or hands (excluding keying activities) for more than 2 hrs. per day	7. Highly repetitive motions
8. Performing intensive keying more than 4 hrs. per day	8. Highly intensive keying
9. Using the hand (heel/base of palm) or knee as a hammer > 10 times per hour for more than 2 hrs. per day	9. Repeated impact (hand or knee)
10. Lifting objects weighing > 75 lbs. once per day OR > 55 lbs. for more than 10 times per day	10. Heavy lifting
11. Lifting objects weighing > 10 lbs., if done more than twice per minute for more than 2 hrs. per day	11. Frequent lifting
12. Lifting objects weighing > 25 lbs. above the shoulders, below the knees, or at arms length more than 25 lbs.	12. Awkward lifting
13. Using impact wrenches, carpet strippers, chain saw, percussive tools (jack hammer, scalers, riveting or chipping hammers) or other hand tools that typically have high vibration levels more than 30 minutes per day.	13. Using high vibration tools
14. Using grinders, sanders, jigsaws or other hand tools that typically have high vibration levels for more than 2 hrs. per day	14. Using moderate vibration tools

Refer to Appendix B of the Washington State Ergonomics Rule for a full description of the twenty-one risk factors and exposure durations that define hazardous jobs. Each job assessment will detail only applicable HZJs. If only one hazardous risk factor applies, only one will be listed.

MANHOLE COVER REMOVAL:
What Methods are Acceptable?

Current removal method: Manual tools such as a T-hook or a sledge/pry bar are often used to remove manhole covers (lids) to allow access into underground vaults. Generally, the worker inserts the tool into a pick hole and uses a jerking motion to unseat the lid. This portion of the task is the "lifting" portion. Still using the tool, the lid is dragged several inches away from the opening. After the work is completed, the lid is dragged back to the opening and is re-seated.

Sometimes the hook is inserted directly on the rim as is depicted in the picture above.

More commonly a longer tool is inserted in an interior hole, as depicted above. Hand height and posture would change as a result.

Manhole covers differ in size, weight, load bearing ability, and pick hole design pattern. This is true within a single utility as well as when compared to lids from a similar type of utility. They differ even more so when compared to a different type of utility (for example, electric versus communications or water utilities).

Since hole patterns are not uniform, the tool insertion point varies with each lid. The pick hole is generally a few inches away from the rim of the lid. The "lifting" portion is considered a partial lift because the worker does not actually bear the entire load of the lid while unseating it. The ring along the lid's far rim supports some of the lid weight.

Assumption: the pick hole's distance from the far rim is greater than 3/4 of the diameter of the lid. Depending on the actual pick hole location, the approximate force requirement to unseat the lid will range between ½ to 2/3 of the total weight. To be conservative, **use 2/3 of the total weight of the lid as the lifting weight** when using the lifting calculator in the Washington State Ergonomics Rule. (When the pick point is on the rim, ½ the total lid weight can be used as the lifting weight.)

*In the best-case scenario**, the maximum weight a person is allowed to lift is 90 lbs. unless the lifting is so infrequent that it is not covered by the rule.*

***NOTE: Best case scenario parameters for lifting—all three conditions must apply:*

1) *lifts done less than once every 5 min.*
2) *hands are positioned between the knees and the waist*
3) *hands are positioned between 0-7" from the toes*

By creating a table that includes size and weight for the commonly used manhole covers per utility, one will know to never attempt the manual removal of specific types of manhole covers. (See sample table on next page). The size/weight of lid will dictate whether or not one person may try to manually remove the manhole cover (for example, lids that weigh ≤ 135 lbs.). A two-person team may attempt manual lid removal for lids that weigh up to 270 lbs. However, if the lid is impacted and does not easily pop out from its ring, a mechanical device should be used.

Even though it takes more effort to unseat impacted lids, utility companies are not required to use force gauges to measure this. The Washington State Ergonomics Rule does not ask nor require this type of measurement for hazard determination. Instead, it strictly relies on item weight as an indirect indicator for lifting force. This can be obtained via a scale, specification sheets, etc. Spring-assisted hinges are frequently used on hinged vault lid doors. Utility workers indicate that by comparison these hinges make the lifts much easier and are not likely to require more than 90 lbs. of force. Thus, a 1-person manual lift would be an acceptable lift. (Force measurements were not taken).

Manhole Cover Weights and Acceptable Lifting Methods

Type of Utility	Diameter	Weight	2/3 Weight	Acceptable Method
Electric	24”	80 lbs. (Tacoma Power)	53	1-person manual method 2-person manual method or mechanical method
	29”	200 lbs. (Tacoma Power)	132	2-person manual method or mechanical method
	38.5”	420 lbs. (Tacoma Power)	277	Mechanical method
	42”	Solid lid—550 lbs. (Seattle City Light)	363	Mechanical method
	42”	Vented lid--445 lbs. (Seattle City Light)	294	Mechanical method
	30”	Solid lid--600 lbs. (Seattle City Light)	396	Mechanical method
	24”	Solid lid—400 lbs. (Seattle City Light)	264	Mechanical method
	3’ x 3’ grate	165 lbs.—reportedly the spring assisted hinges make it much easier to open.	109	1-person manual method
Water	??	75-90 lbs (City of Everett)	50-59	1-person manual method 2-person manual method or mechanical method
Spring assisted hinged lid	??	100 lbs. per side (City of Everett)--reportedly the spring-assisted hinges make it much easier to open.	66	1-person manual method
Other: grates	??	35 lbs. (City of Everett)	23	1-person manual method 2-person manual method or mechanical methods
Sewer	24”	145-155 lbs. (City of Vancouver, WA)	96-102	2-person manual method or mechanical method
Communications				
WUEG does not have any members from communications so does not have this information. The blank row is provided for illustrative purposes.				

A mechanical assist device should be used for impacted lids

135 lbs is the maximum lid weight for 1-person manual method ***270 lbs. is the maximum lid weight for 2-person manual method***

Examples of mechanical assist devices:

These pictures illustrate some examples of devices that may reduce exposure to heavy lifting. Each utility will need to determine which device will be appropriate for their facility. Not every device is designed to lift every type of manhole cover. Some can be used for only a limited range of weight and lid diameter.

Hydraulic hand pump

COMPONENT METHOD

Background:

There was strong belief among Western Utilities Ergonomics Group (WUEG) members that utility jobs were difficult to evaluate because it was hard to define a "typical day". One day of work could be very different from the next day of work. A crew may perform a wide mixture of jobs over the course of a day, a week, or a month. A crew may do the same type of job assignment for a day, followed by 4 days of a different type of job assignment, then followed by a few days with mixed job assignments. WUEG members were frustrated by not knowing what to consider as a typical workday. Field workers also responded the same manner when they were interviewed.

This section of the demonstration project gives an overview of the Component Method that was developed and tried on a highly variable job. This document provides results for the first trial use of the component method on the lineworker job. Results of the data provide individual risk factor exposure rates per job component. By knowing the amount of time spent in the broad categories, one can easily determine the exposure time per risk factor. For example, 21% of the total time working in-the-bucket is spent using a forceful grip. Thus five hours of working in-the-bucket means 63 minutes exposure to forceful gripping.

Results from the Component Method show that realistically, lineworkers will not reach caution zone status for any risk factor during any given workday consisting of underground work or bucket work. ****Exception:** Since work sampling is not the best method to use for infrequent events, **heavy lifting** was evaluated separately. (See the lineworker report for details and complete assessment results).

We hoped to find that most jobs could be assessed via the Labor & Industries caution zone checklist method without needing to use the component method. This was confirmed by the end of the project. After seeing the component method results, members became convinced that exposure times were much lower than they originally believed. Thus, they became much more confident to decide whether exposures reached caution and hazard zone levels or not.

Component Method:

Components are mutually exclusive broad categories. For the most part they are based on work location and are limited in number. Examples include in-the-bucket; on-the-pole; underground; site set up/clean up; travel/paperwork or planning; and prep work at home base. Large broad categories are chosen because it is easier to estimate the total time spent in a day while working in a bucket than it is to estimate time spent doing a vast array of tasks and activities (for example,., installing a transformer, using a hotstick, crimping wire, pulling wire, etc). There is so much difficulty distinguishing between activities and tasks that it becomes a futile exercise due to a lack of consistency in terms and an intermixing of level of detail.

A Labor & Industries ergonomist proposed using a work sampling method (component method) for the lineworker job. The component method can also be applied to other highly variable jobs. Lineworker activities were first categorized into components.

This method of work sampling involved recording the presence of risk factors for a worker at discrete 60-second intervals. Work sampling was done solely from videotaped work, not in real time. Data came from two different components (in-the-bucket and underground work). Five 1-hour data sets were collected for each component. The pooled data was used to determine risk factor exposure rates per job component. Data sets came from different utilities.

> *A decision was made to collect data for just two work components for the lineworker. WUEG agreed that workers have the greatest exposure to risk factors while working in-the-bucket and while doing underground work. Lineworkers climb poles and work from the pole on such a limited basis that data samples could not be collected for this project. Heavy lifting exposures from other components such as those encountered while loading trucks is accounted for within the lineworker full job assessment.*

The following list describes the group process used for learning and completing the component method from start to finish:

- Defined components for the lineworker job
- Reviewed the fourteen risk factors that define caution zone jobs
- Trained members to record risk factor data using frozen frames from videotape. Reviewed videotapes and practiced recording information as a group.
- Provided tips for the best ways to videotape the work and suggested conveying some verbal information on the videotape. (Verbal cues can help when there is a brief obstructed view or for scenarios when the camera person stands well below the level of the worker. In such cases it

is difficult to discern awkward postures simply from a two dimensional image on a videotape.)

- Added other information to the data collection sheet. WUEG wanted to collect additional data on: awkward wrist postures; neck extension; high push/pull force—shoulders; and high push/pull force—whole body.
- Gave out assignments to members: film lineworkers doing work in component 1 (while in-the-bucket)
- Members recorded work sampling information from their 1-hour data set on data sheets
- Reviewed results of preliminary data and when completed, of pooled data (Five 1-hour data sets) for component 1
- Gave out assignments to members: film lineworkers doing work while doing work in component 2 (underground work)
- Reviewed results of pooled data (Five 1-hour data sets) for component 2
- Discussed the meaning of the results and how to apply the results with the group
- As a group, completed a caution zone job assessment and hazard level assessment for the lineworker job. Specifically discussed all items the group knew to be lifting hazards. Listed the weights and potential hand positions for the lifts. Discussed ways to reduce the hazardous exposures.

See lineworker full job assessment.

RESULTS:

Sampling Data for Two Components

Shaded cells are those with percentages > 10%

Risk Factors (short description only)	Component 1 Lineworkers: In-the-Bucket n=295 Frequency	% of Samples	Component 2 Lineworkers: Underground work n=297 Frequency	% of Samples
0. No exposure	151	51%	67	23%
1. Hand(s)overhead	49	17%	11	4%
2. Neck bent	30	10%	66	22%
3. Back bent >30°	25 (+3)	9%	42 (+ 45)	29%
4. Back bent >45°	3	1%	45	15%
5. Squatting	0	0%	37	12%
6. Kneeling	0	0%	66	22%
7. Pinch >2# or 4# force	13	4%	24	8%
8. Grip>10#	61	21%	95	32%
9. Repetitive motion every few secs	23	8%	30	10%
10. Awkward wrist (F30; E45; UD30)	5	2%	37	12%
11. Intensive keying	0	0%	0	0%
12. Repeated impacts (hand or knee)	0	0%	0	0%
13. Lifting (must be >10 #)	18	6%	6	2%
14. Moderate vibration tool	0	0%	1	0%
15. High vibration tool	0	0%	0	0%
201. Neck extension	28	9%	7	2%
202. High push/pull force—shoulders	6	2%	6	2%
203. High push/pull force--whole body	0	0%	2	1%

NOTE: Heavy lifting is not well suited for work sampling methods because it happens on an infrequent basis. Lifting will be addressed by other means using known weights of items.

ALSO: Awkward wrist exposures are likely to be underestimated. Videotaped work periods could not include wrist postures of workers all of the time. Awkward wrist postures were counted as exposures only when awkward wrist position was actually observed in the video at the sampling interval or if there was strong likelihood based on similar, yet non-obstructed views observed on the videotape.

Interpretation of Sampling Data:

While the lineworker performs duties **in-the-bucket**…	While the lineworker performs duties **in underground work**…
○ 21% of the time the worker used a forceful grip (> 10 lbs. of force or holding item >10 lbs) ○ 17% of the time the worker had his/her hand(s) overhead or elbow(s) above shoulder height	○ 32% of the time the worker used a forceful grip (> 10 lbs. of force or holding item >10 lbs) ○ 29% of the time the worker had a bent back > 30° ○ 23% of the time the worker had no exposure to risk factors ○ 22% of the time the worker had a bent neck posture ○ 22% of the time the worker was kneeling ○ 15% of the time the worker had a bent back > 45° ○ 12% of the time the worker was squatting ○ 12% of the time the worker had awkward wrists
○ 51% of the time the worker had no exposure to risk factors	○ 23% of the time the worker had no exposure to risk factors

The percentage of samples value (*for the pooled data set*) can be used for an exposure rate. Use the percentage as a multiplier to determine risk factor exposure time
Example:

Amount of time doing work in component 1	X	Multiplier for gripping	=	Amount of gripping exposure for component 1

Interpretation (continued):

Example for in-the-bucket--**component 1**:

	Risk Factor	Exposure Time
If a worker spends 5 hrs a day doing in-the-bucket work	Not exposed to risk factors	153 mins
	Hand(s) overhead or elbow(s) above shoulder height	51 mins
	Forceful grip > 10 # of force	63 mins

Example for underground work--**component 2**:

	Risk Factor	Exposure Time
If a worker spends 3 hrs a day doing underground work	Forceful grip > 10 # of force	58 mins
	Bent back >30°	52 mins
	Not exposed to risk factors	41 mins
	Bent neck >30°	40 mins
	kneeling	40 mins
	Bent back >45°	27 mins
	Squatting	22 mins
	Awkward wrist posture	22 mins
	Not exposed to risk factors	14 mins

- If you know the duration for all of the components of the workday, you can add the parts together to determine the worker's whole-day exposure to a risk factor.

To illustrate using the durations from examples 1 plus 2:

Amount of time doing work in a component 1	X	Multiplier for gripping (0.21)	=	Amount of gripping exposure component 1
Amount of time doing work in a component 2	X	Multiplier for gripping (0.32)	=	Amount of gripping exposure component 2

(300 mins) x (0.21) = 63 mins forceful gripping in component 1

\+ (180 mins) x (0.32) = 58 mins forceful gripping in component 2

121 mins forceful gripping for both components

If these durations accurately reflect a typical workday, this job would be a caution zone job (CZJ) because of forceful gripping, but would not be a hazard zone job (HZJ).

Interpretation (continued):

On the other hand, if a worker is limited to doing work in a <u>single</u> component…

For in-the-bucket work:

Risk Factor	Component time threshold to be a CZJ	To reach the hazard level of exposure by doing in-the-bucket work…
Forceful gripping	>9 hrs and 32 mins	Excessively high and improbable—N/A
Hand(s) overhead or elbow(s) above shoulder level	>11 hrs and 46 mins	Excessively high and improbable—N/A

For underground work:

Risk Factor	Component time threshold to be a CZJ	To reach the hazard level of exposure by doing underground work… *(these are also excessive and highly improbable but are provided for illustrative purposes)*
Forceful gripping	>6 hrs and 15 mins	If forceful gripping only…>12 hrs and 30 mins If combined with high repetition. > 9 hrs and 22 mins If combined with awkward wrist posture...> 9 hrs and 22 mins If combined with high repetition + awkward wrist posture... >6 hrs and 15 mins
Bent back > 30^{o}	>6 hrs and 54 mins	> 13 hrs and 48 mins
Bent neck	>9 hrs and 15 mins (bent >30^{o})	Must be a 45^{o} neck bend <u>and</u> > 18 hrs and 11 mins
Kneeling	>9 hrs and 15 mins	> 18 hrs and 11 mins

Meter Reader	Water	City of Everett
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Opens in-ground meter boxes to view meter dial and enters information into handheld data-logger. Drives or walks to each location.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30° or back bent > 30°	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	Holds a handheld data-logger (2.5 lbs) for approx. 3 hrs./day. Uses an intermediate grip between a pinch and a fist grip. Generally, it rests on the palm and force is not continuously applied. Does not reach 2 hrs. of gripping or pinching. There is a hand strap that keeps the data-logger snug to the hand. Neck straps can also minimize the total grip time.
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

The Meter Reader position does not include caution zone jobs; therefore, the job is not covered by the rule.

NOTE: The work process will be changing soon. By the end of 2002, Water Meter Readers for the City of Everett will be driving past the meter to pick up radio signaled information rather than manually opening the vault lids to read the meters. Exposure to risk factors are likely to be even less than the current levels of exposure.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Supervisor	Water	City of Everett
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Visits crews in the field to direct work. Field visits can include inspection of vaults and manhole cover removal.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30^{o} or back bent > 30^{o}	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	NOTE: Manhole covers weigh up to 90 lbs. however, lid removal does not meet the caution zone criteria because the agreed upon calculated partial-lift weight is 60 lbs. Also, this utility already uses 2 people for lid removal or uses a mechanical assist device. These methods reduce the exposure to heavy lifting so that it does not become a caution zone job.
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

The supervisor position does not include caution zone jobs; therefore, the job is not covered by the rule.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Meterman – Meter & Relay Tech.	Electric	Clark Public Utilities
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Installs, tests, adjusts, and repairs or replaces electric meters and devices. Installs wiring to related equipment.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30^{o} or back bent > 30^{o}	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

The Meterman position does not include caution zone jobs; therefore, the job is not covered by the rule.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Laboratory Assistant	Water	Seattle Public Utilities
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Collects distribution system drinking water samples along assigned routes and performs field measurements for temperature, chlorine residual and pH. Downloads route information to a hand-held computer before leaving on the route. Uploads the field information from the hand-held computer to the laboratory LIMS system, resolves any problems, and delivers samples to appropriate laboratory for analysis when returning. Performs reservoir patrol function to ensure security has not been breached, to check for any water quality problems, and to collect data on observations about bird populations. Provides support to the laboratory by cleaning and autoclaving glassware, maintaining stocks of clean and labeled sample bottles, and assisting analysts with media and stock preparation.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30^{o} or back bent > 30^{o}	**YES**	Washing containers in the sink, other counter work tasks
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

No hazard level of exposure was reached in this job. Thus there are no requirements to change the job or reduce the exposure levels. However, ergonomics awareness education must be provided to the Laboratory Assistants and their supervisors because the job is a caution zone job.

Other employers may use this job assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Microbiologist	Water	Seattle Public Utilities
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Provides journey level analytical services to help ensure the water quality of the distribution system. Conducts microbiological analyses for total and fecal coliform, Pseudomonas, fecal streptococci and heterotrophic plate counts (HPC) in treated distribution water, raw source waters and reservoirs using membrane filtration, multiple-tube fermentation, presence/absence tests and pour plates to meet state and federal water quality regulations. Measures chlorine concentrations, water temperature, and pH and performs other field tests. Enters data and generate reports. Analyzes test results. Provides expertise to assist in the design of special studies to evaluate the impacts of treatment or regulatory changes.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30^{o} or back bent > 30^{o}	**YES**	Neck bent during a combination of all counter work
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	**YES**	HPC shaking and pipeting, capping and uncapping bottles, and using tweezers
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

No hazard level of exposure was reached in this job. Thus there are no requirements to change the job or reduce the exposure levels. However, ergonomics awareness education must be provided to the Microbiologists and their supervisors.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Chemist	Water	Seattle Public Utilities
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Plans, schedules and coordinates work in the Chemistry lab to ensure timely and accurate compliance with drinking water regulations. Evaluates analytical results and associated QC to ensure data accuracy and precision. Performs specialized chemical analyses of drinking water, including organics, metals and conventional chemistry. Train analysts and senior lab assistants in the chemical analysis of drinking water. Plans and conducts special water quality studies to support drinking water treatment and operations. Operates laboratory instruments such as gas chromatograph, TOC analyzer, Rapid Flow Analyzer for nutrients, UV spectrophotometer, GFAA analyzer for trace metals, pH meter, etc. Uses lab equipment such as balance, pipette, titration equipment, etc.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	**MAYBE**	Phase removal pipetting under the laminar flow hood
2. Neck bent > 30^{o} or back bent > 30^{o}	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

Discussion:

Although there is the possibility of reaching two hours of exposure for hands overhead or elbow(s) above the shoulder, the worker certainly would not reach the hazard level of exposure in this job. Thus, there are no requirements to change the job or reduce the exposure levels. However, ergonomics awareness education must be provided to the Chemists and their supervisors unless the employer reasonably determines that they are not in the caution zone.

Other employers may use this job assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Utility Electrician	Electric	Mason County PUD
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Performs electrical work for utility including: emergency repair of customer underground secondary faults; emergency repair of customer service up to and including main panel; splices, tests, and maintains fiber optic lines.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30° or back bent > 30°	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	**YES**	Using hand tools (screw drivers and tools for splicing fiber optics)
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

No hazard level of exposure was reached in this job. Thus there are no requirements to change the job or reduce the exposure levels. However, ergonomics awareness education must be provided to the Utility Electricians and their supervisors.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Vactor Truck Operator	Water district	Woodinville Water District
Job Title	**Type of utility**	**Company Name**

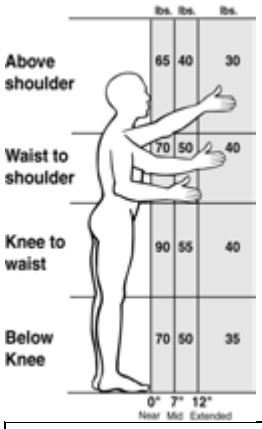
Short description of job duties: Jet sewer lines using a high-power nozzle and water line attached to a Vactor truck. Spray debris with water gun during jetting. Use a suction tube to extract excess water in plugged lines or excavation ditches. Suck out dirt from excavation site. Each task involves handling equipment or operating controls. Other duties involve scheduling activities, driving to the locations, set up and various other duties.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30° or back bent > 30°	**MAYBE** (only during annual maintenance projects)	Looking into the sewer hole and when guiding the hose reel.
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	These operators use a foot control to operate the hose reel controls during jetting. This eliminates gripping a handheld control. These operators use a trigger lock on the water gun so that they do not constantly grip the trigger.
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	**YES**	Manhole covers—depends on lid weight
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT



A. Lifting Hazard(s): Yes

Table itemizes all lifts that called for the hazard level of assessment

NOTE: If the same item is lifted from different positions, two or more hand zone numbers appear in the Hand Zone cell (e.g., lifting from ground level and lifting off the truck bed).

Item Lifted	Weight (in lbs.)	Frequency Factor	Twist Factor	Hand Zone(s) *(Use number from lifting calculator picture)*	Is it a Hazard?
1. Manhole covers (lids) using traditional manual method	Variable- Up to 155	1	1	90	**YES** (depends on lid weight)

B. Hazard due to Back Bent >30° for > 4 hrs. per day OR Back Bent >45° for > 2 hrs. per day: *To be determined.*

For most days of the year, the durations do not even reach caution zone job levels of exposure. For the limited 2-week period of each summer that the crew does intensive jetting tasks, exposures most likely will reach CZJ levels and perhaps HZJ levels of exposure for bent back. An assessment that considers this period of concentrated work activities will need to be done. (This may be better evaluated during the annual maintenance period when activities can be observed or be freshly recalled.)

HAZARD REDUCTION EXAMPLES

⇒ **Lifting Manhole covers:** See separate section on manhole cover removal for further details. Recommendations: one person may use the traditional manual method for removing lids weighing up to 135 lbs. Likewise, two people can use the traditional manual method for lids weighing up to 270 lbs. All lids outside of those weight ranges require a mechanical assist. Some examples include wheeled and non-wheeled lid extractor devices, truck mounted cranes, and truck booms with a winch. Some tools incorporate leverage so that the user pushes down on the tool handle rather than lifting it

or pulling up on it. Lightweight manhole covers made from composite materials can also be used for some applications. A mechanical assist should be used for all impacted lids due to the increased difficulty to unseat these lids.

⇒ **Potential Hazard for neck/back bent:** Operators try to keep the water line hose centered through the manhole while guiding the hose and hose reel. They often stand with awkward postures in order to maintain the optimum hose placement in the hole. Recommendations: 1) A possible way to reduce neck/back bending is to mount an extension to the handle of the hose reel guide. By using a longer handle, the worker would not need to lean forward to manage the hose reel guide. 2) Job rotation can be used so that workers switch job tasks with one another, splitting the total exposure time between the two workers.

EXPOSURE REDUCTION EXAMPLES ALREADY AT WORK

⇒ **Gripping hose reel remote control device:** Operators use foot pedals instead of hand controls to control the water line hose in the sewer access port (SAP).

⇒ **Gripping trigger of water gun:** Operators use a trigger lock to hold the trigger in the open position to alleviate the need for a constant grip.

Discussion:

This employer is responsible for:

- Ergonomics awareness education for Vactor Truck Operators and their supervisors
- Reducing the hazardous lifting exposures to below the hazard level
- Annual review of caution zone jobs
- Determining if risk factor exposures during the concentrated annual maintenance activities are hazardous. Address hazards if present.

Employees must be involved in hazard assessment and when selecting measures to reduce WMSD hazards.

Other employers may use results of this job assessment as a useful comparison, but will need to determine if their own employees have similar exposures. For example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/activities provided in this assessment, that employer needs to do its own analysis.

Wire Room – Wireman	Electric	Seattle City Light
Job Title	**Type of utility**	**Company Name**

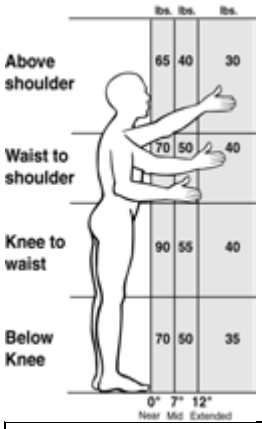
Short description of job duties: Takes requests for specific wire from Line Crew/Underground Crew. For precut wire, will locate coil in warehouse and deliver it to the appropriate dock. If wire is special order or is out of stock, will locate appropriate reel and move it to the measuring/-cutting area. Will mount reel onto rack; pull wire through meter and onto wire coiler; and cut to desired length using pneumatic cutter or hand cutter. Transports items with a hand truck, wire truck or forklift. May roll wire coil from point to point, rather than using mechanical means.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30° or back bent > 30°	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	**YES**	Coils of pre-cut wire; lifting coils of wire on/off the coiling machine or hand truck; making hand coils or placing them in stock.
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT



Lifting Hazard(s): Yes

Table itemizes all lifts that called for the hazard level of assessment

NOTE: If the same item is lifted from different positions, two or more hand zone numbers appear in the Hand Zone cell (e.g., lifting from ground level and lifting off the truck bed).

Item Lifted	Weight (in lbs.)	Frequency Factor	Twist Factor	Hand Zone(s) *(Use number from lifting calculator picture)*	Is it a Hazard?
wire coils	Most are <78 lbs.	1	1	**90**	NO
				70	**YES if coil weighs > 70 lbs.**
	but did find a 108 lb. and 132 lb. coil			**90**	**YES**
				70	**YES**

HAZARD REDUCTION EXAMPLES

Handling wire coils: Recommendations: 1) Store heavier coils of wire (weighing >70 lbs.) standing upright in floor level storage areas. Lighter wire can be stored in the higher 2nd level storage areas. 2) Roll the wire coils instead of lifting them. This includes rolling wire coils into and out of the storage areas when it is possible. 3) If the wire coil is positioned horizontally on a surface, tip the coil to stand it upright rather than lifting it, so that it can be rolled. 4) Use hand trucks to transport coils of wire. 5) For heavy coils, use 2 people to lift the coil or use a mechanical assist such as a forklift. 6) Limit lengths for hand coils so that they weigh less than 90 lbs. For exceptional jobs that require longer, heavier sections of wire, the hand coils will be handled by 2 people or by mechanical means.

Discussion:

This employer is responsible for:

- Ergonomics awareness education for Wire Room – Wireman and their supervisors
- Reducing the hazardous lifting exposures to below the hazard level
- Annual review of caution zone jobs

Employees must be involved in hazard assessment and when selecting measures to reduce WMSD hazards.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Lineworker	Electric	From pooled data of several electric utilities
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Lineworkers are responsible for maintaining power lines in good and safe condition. General tasks include installing new overhead and underground services, removing old services or hardware, and maintaining existing services. This includes installation/removal of items such as: transformers, wire, insulators, poles, crossarms, etc.

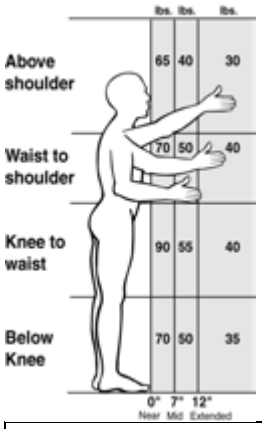
CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
⇒ Hand(s) overhead	NO	
⇒ Neck bent > 30° or back bent > 30°	NO	
⇒ Squatting	NO	
⇒ Kneeling	NO	
⇒ Pinching > 2 lbs. or > 4 lbs. of force	NO	
⇒ Gripping > 10 lbs. or > 10 lbs. of force	NO	
⇒ Highly repetitive motions	NO	
⇒ Highly intensive keying	NO	
1. Repeated impact (hand or knee)	NO	
2. Heavy lifting	**YES**	Crossarms, feeder arms, compacter, string of bells, hand coil wire, guy wire, triple helix swamp anchor, 7 foot anchored rods, pole trailer tongues, manhole covers.
3. Frequent lifting	NO	
4. Awkward lifting	NO	
5. Using high vibration tools	NO	
6. Using moderate vibration tools	NO	

NOTE: Although not covered by the Washington State Ergonomics rule, WUEG indicates lineworkers generate very high muscle forces in shoulder girdle muscles when they use manual cutting and compression tools. WUEG believes these are also likely to contribute to the WMSD risk.

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT



A. Lifting Hazard(s): Yes

Table itemizes all lifts that called for the hazard level of assessment

NOTE: If the same item is lifted from different positions, two or more hand zone numbers appear in the Hand Zone cell (e.g., lifting from ground level and lifting off the truck bed).

Item Lifted	Weight (in lbs.)	Frequency Factor	Twist Factor	Hand Zone(s) *(Use number from lifting calculator picture)*	Is it a Hazard?
1. Crossarm or feeder arm	34-80	1	1	90	NO
2. Pole trailer tongue	Approx. 100-150	1	1	70 90	**YES** **YES**
3. Compacter	139	1	1	90 50	**YES** **YES**
4. String of bells	84	1	1	70	**YES**
5. Wire (hand coil)	Heaviest wt.=100	1	.85	90 70 65	**YES** **YES** **YES**
6. Guy wire factory 3/8" and 7/16"	Heaviest wt.=140 and 200	1	.85	90	**YES**
7. Triple helix swamp anchor	85	1	.85	90 70	**YES** **NO**
8. 7 ft. anchored rod	55	1	.85	90	NO
9. Manhole covers (lids)	Variable: up to 600 lbs.	1	1	90	**MOSTLY - YES**

HAZARD REDUCTION EXAMPLES

⇒ **Pole trailer tongue (item 2):** The pole tongue is an attachment used at the end of a pole. It provides a way to tow a pole to a job site. It is attached after the pole is placed, balanced, and is secured on a trailer. The pole itself then becomes what is called the tongue of the trailer. Recommendation: Use 2 people to attach the pole trailer tongue to the hitch. Also, ensure that the pole is positioned on the trailer so as to balance the load with just enough tongue weight to offer the best trailer handling while being towed, and to minimize the force required to lift/maneuver the pole tongue by hand onto the hitch of the towing vehicle.

⇒ **Compacter (item 3):** Recommendation: For most scenarios the hazard is effectively reduced if two people lift the compacter. For the scenario that sometimes occurs when the compactor is in the trench, but needs to be lifted up out from the bottom of a 2-3 foot trench, the two-person lift is NOT OK. Instead use a mechanical assist such as tying a line from a truck winch to lift the compacter out of the trench.

⇒ **String of bells (item 4):** Lineworkers may work with strings of bells while working from a bucket in the air or while still on ground level (before going up in the bucket). The bells generally come in strings of six bells. The lifting/ handling exposures occur when the lineworker is on ground level in instances such as: loading/unloading the truck, removing them from the packing carton, and lifting and supporting them while attaching the hook to an eyebolt. Recommendation: For lifts that are other than near to the body and between knee and waist height, use two people to lift the string of bells. Other ways to reduce the hazard is to have the manufacturer reduce the number of bells on the string or to substitute the string of bells with a lighter item such as an epoxilator.

⇒ **Hand coiled wire and (3/8" and 7/16") guy wire (items 5 and 6):** Recommendations: 1) When the wire is unused and still heavy (over 90 lbs.), use 2 people to lift the coil or use a mechanical assist such as the truck boom with a winch or a man-hoist adaptation device to lift the coil of wire. 2) Workers can cut smaller sections of the wire off as needed instead of handling the whole coil. 3) Have the warehouse worker or wire supply company limit hand coil weight to 90 lbs. or less. For exceptional jobs that require longer, heavier sections of wire, the hand coils will be handled by 2 people or by mechanical means.

⇒ **Triple helix swamp anchor (item 7):** Recommendation: Based on the common hand positions when lifting this item, it is hazardous when it is lifted from below the knees or between waist and shoulder height (Hand Zone 70). Use two people to lift this if lifting from these areas.

⇒ **Manhole covers (item 9):** See section on manhole cover removal for further details. Recommendations: one person may use the traditional manual method for removing lids weighing up to 135 lbs. Likewise, two people can use the traditional manual method for lids weighing up to 270 lbs. All lids outside of those weight ranges require a mechanical assist. A mechanical assist should be used for all impacted lids due to the increased difficulty to unseat these lids. Some examples include wheeled and non-wheeled lid extractor devices, truck mounted cranes, and truck booms with a winch. Some tools incorporate leverage so that the user pushes down on the tool handle rather than lifting with it. Lightweight manhole covers made from composite materials can also be used for some applications.

Discussion:

This employer is responsible for:

- Ergonomics awareness education for Lineworkers and their supervisors
- Reducing the hazardous lifting exposures to below the hazard level
- Annual review of caution zone jobs

Employees must be involved in hazard assessment and when selecting measures to reduce WMSD hazards.

Other employers may use this assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Customer Field Service Tech	Gas (also electric)	Puget Sound Energy
Job Title	**Type of utility**	**Company Name**

Short description of job duties: Installation, repair and adjustment of appliances, meter work, etc. Identifies, pinpoints and classifies gas leaks; repairs damaged service lines; takes odorant tests and reports results. The position generally involves frequent sitting, standing, walking, bending, reaching, kneeling, twisting, balancing, and climbing.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30° or back bent > 30°	NO	
3. Squatting	NO	
4. Kneeling	**YES**	Repairing broken gas lines and customer gas equipment and appliances.
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	NO	
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	NO	
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT

Discussion:

No hazard level of exposure was reached in this job. Thus there are no requirements to change the job or reduce the exposure levels. However, ergonomics awareness education must be provided to the Customer Field Service Techs and their supervisors.

Other employers may use this job assessment as a useful comparison, but will need to determine if their own employees have similar exposures. As an example, the worker for a different employer may perform additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/ activities provided in this assessment. That employer needs to do its own analysis.

Gas Fitter	Gas (also electric)	Puget Sound Energy
Job Title	**Type of utility**	**Company Name**

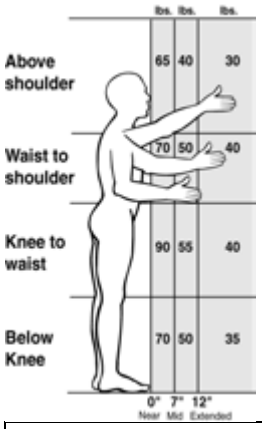
Short description of job duties: Constructs, installs, maintains, inspects and operates gas-piping systems. Job position primarily handles the first response to leaks and performs repair. Construction aspects of the job are now contracted out. Activities generally involve occasional sitting, frequent standing, frequent walking, moderate to heavy lifting, moderate carrying, frequent bending, reaching, kneeling, twisting, balancing, and climbing.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30° or back bent > 30°	NO	
3. Squatting	NO	
4. Kneeling	**YES**	Repairing broken gas lines
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	**YES**	Lifting jackhammer from awkward positions in/out of the truck and while using it. Unfolding the truck lift gate.
11. Frequent lifting	NO	
12. Awkward lifting	NO	
13. Using high vibration tools	**YES**	Jackhammer, air shovel, and rock drill
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at a particular utility. The results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT



A. Lifting Hazard(s): Yes—see all "YES" listings in table

Table itemizes all lifts that called for the hazard level of assessment

NOTE: If the same item is lifted from different positions, two or more hand zone numbers appear in the Hand Zone cell (e.g., lifting from ground level and lifting off the truck bed).

Item Lifted	Weight (in lbs.)	Frequency Factor	Twist Factor	Hand Zone(s) *(Use number from lifting calculator picture)*	Is it a Hazard?
1. Jackhammer (without tip)	86	1	1	50	YES
				90	NO
2. Jackhammer (with tip)	94	1	1	90	YES
3. Jackhammer (with tip)	94	0.3	1	90	YES
4. Truck lift gate	73 *see below	1	1	50	YES
				70	YES

***Optional Information:** The Gas Fitter has to manually unfold and position the lift gate on the back of the truck so that it can be used. It is attached with a hinge and has a spring to make it easier to manually lift. In this case the worker does not completely lift the total weight of the item as is true with a pure "lift". This type of lift would be considered a partial lift. Even though the weight is not known the employer provided other information that is not required by the Ergonomics Rule. The employer provided the force that is needed to unfold and position the lift gate for use. A force gauge was used to take these measurements. These force measurements are used in the table instead of weight. The employer identified lift gate handling as a problem that they needed to address.

HAZARD REDUCTION EXAMPLES FOR LIFTING

⇒ **Lifting jackhammers (items1-3):** Lifting the 89 lb. jackhammer out of the truck is not a WMSD hazard but would be if the combined jackhammer and chisel weight exceeds 90 lbs. Commonly, a worker tips the jackhammer from ground level to an upright position. Thus, the lifting weight from ground level is at maximum ½ of the total weight of the jackhammer. Once in the upright

position, the worker lifts the jackhammer by the handles from about waist height. Tipping the jackhammer up from the ground is not a lifting hazard. However, a WMSD hazard exists with frequent lifting of the heavy tool during normal operation of a jackhammer. See discussion section for further details.

Recommendations: 1) Use a machine mounted hydraulic pavement breaker (on a backhoe, excavator, etc.) whenever possible. Doing so eliminates heavy lifts and hand-arm vibration exposure related to jackhammer use.
2) Use a walk-behind concrete saw to score and cut the designated area instead of using a jackhammer. Positioning this device does not involve lifting. 3) Use two people when lifting jackhammers that weigh more than 90 lbs. during equipment loading and unloading.

The following recommendations reduce lifting exposures but do not reduce exposures below the hazard level. 4) If manual jackhammering must be done, limit its use to less than 1 hr. per day and use job rotation to keep exposures below this level. 5) If a jackhammer must be used, store the jackhammer in easy to reach locations such as in a holster mounted at an angle on the compressor; storing it in an external cabinet with a low floor and a swing away door so that that it does not have to be lifted over an obstruction; or use a hinge-mounted rod or a bracket that allows the jackhammer to be tilted between horizontal to vertical positions for better positioning while loading or unloading.

Courtesy of Ira Janowitz
UC San Francisco/Berkeley
Ergonomics Program

Puget Sound Energy started installing lower racks for the jackhammers. The Gas Fitter leans the jackhammer into a bracket, then rotates it up on end to load it into the truck.

⇒ **Lift gate handling (item 4):** This recommendation is the solution that the employer developed and already implemented: Install a stronger spring to the lift gate.

Puget Sound Energy contacted the lift gate manufacturer and inquired about changing the spring. The manufacturer sent larger springs to replace the original springs. The lifting force requirement was reduced from 73 lbs. to 30 lbs. Crewmembers are pleased that the lift gates are much easier to manage.

(CONTINUE TO NEXT PAGE FOR JACKHAMMER DISCUSSION)

Discussion

Jackhammer Operation – Frequent Lifting of Heavy Jackhammers

Utility industry assumptions:
1. Workers use jackhammers for less than 1 hr. per day
2. Hydraulic machine mounted breakers are used for large jobs and when space affords their use.

Situations remain where manual 60 lb. and 90 lb. jackhammers must be used. The maximum acceptable lifting weight is 27 lbs for the given parameters of less than 1 hr. per day, 10+ lifts per minute, and hand location close to the body between knee and waist height. This is a hazardous exposure for either jackhammer. This is still true even if the lift frequency is 8-9 per minute.

Possible options:

- Explore the feasibility of using a small walk-behind mechanical device with a hydraulic breaker attachment. Consider renting a walk-behind device with a hydraulic breaker attachment on a trial basis to determine if this is an appropriate alternative to a manual jackhammer.

- Explore the feasibility of using a rock drill combined with a hydraulic splitter as an alternative to a manual jackhammer. The method involves drilling a series of holes along the desired cracking line and placing a splitter tool in the hole. Subsequently, the pressure build-up causes the concrete or asphalt to split along the series of holes.

- A prototype of a jackhammer lift-assist device has been made. Currently, field tests are being conducted on it as part of a gas utility funded project (NYGAS Millennium Project M-2001-011). This is the second-generation prototype. The device is designed to push the embedded jackhammer chisel out of the concrete using an actuator. The operator mainly uses his/her hands to guide and stabilize the jackhammer rather than lift the tool, as before. The primary reason the device was designed was to reduce the force required to unseat a stuck jackhammer chisel. Coincidentally it will also address the frequent lifting problem that leads to the WMSD hazard. (NOTE: The combined weight of the jackhammer plus the device makes it heavier, however, the operator is no longer required to lift the jackhammer to reposition it during normal operation. Workers will still need to lift the jackhammer while loading it on/off the truck). The device is not available commercially at this time. Should this

lift-assist device become available in the future, it may effectively reduce the lifting exposure to below the hazard level. (The device was designed by Stu Senator of Dunton Design Associates, Inc.: http//dunton.senator.net)

- A third generation prototype, "RAPTOR III", was developed to break up pavement quietly and efficiently (Department of Energy and Brookhaven National Laboratory). The device uses a helium driven gas gun to fire a series of nails into the pavement/concrete. Raptor III is bulky and slower than a jackhammer. It would require further improvements before it could become a viable alternative. This device is not available commercially at this time.

While current practices will continue to be used, employers using this type of equipment should periodically review the availability of feasible alternatives that will reduce the lifting hazards associated with these tools.

B. Exposure to Moderate to High Hand-Arm Vibration: Likely hazard

Hazard determination is based on the vibration level of each specific tool (make and model) and the length of time the tool is used. Those numbers are plotted as coordinates into the Hand-Arm Vibration graph (Appendix B of the WA Ergonomics Rule) to determine if a vibration hazard exists.

Vibrating Hand Tool	Make/Model #	Vibration Level	Duration	Is it a Hazard?
Jack hammer	Thor Model 125	Not Found	1 hr.	Likely
Air shovel (chipping hammer with clay spade)	Brand unknown Model OA143	Not Found	30 min.	Unable to determine
Rock drill	Thor Model 28	Not Found	30 min.	Likely

Although a hazard cannot be specifically determined without knowing the vibration levels of the air shovel, jackhammer, and rock drill it is very likely that a vibration hazard exists with these tools. It is common for 60 and 90 lb. Jack-hammers to have vibration levels in the neighborhood of 19 m/s^2 and rock drills of 24 m/s^2. Field measurements using older 60 lb. jackhammers have even been measured above 80 m/s^2 (See tables in Appendix 1). In view of that, it is advisable to reduce the hand-arm vibration exposure due to the likeliness of a hazard. Several options exists to reduce the exposure: 1) Use alternative methods to break up the pavement that do not subject workers to hand-arm

vibration such as a hydraulic breaker attachment on a backhoe, 2) Use lower vibration tools, and 3) Limit the exposure time, perhaps by incorporating job rotation.

Appendix 1 and Appendix 2 are provided as general guidance references listing field vibration measurements and manufacturers' declared vibration values for some demolition tools. Some reduced vibration jackhammers are listed in Appendix 2.

This employer is responsible for:

- Ergonomics awareness education for Gas Fitters and their supervisors
- Annual review of caution zone jobs
- Annual review of jackhammer lifting hazard--revisiting feasible alternatives to reduce the hazardous lifting exposures to below the hazard level.

Employees must be involved in hazard assessment and when selecting measures to reduce WMSD hazards.

Other employers may use results of this job assessment as a useful comparison, but will need to determine if their own employees have similar exposures. For example, the worker for a different employer performs additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/activities provided in this assessment, that employer needs to do its own analysis.

Maintenance Worker 2 (Waste water crew member)	Sewer	City of Vancouver (WA)
Job Title	**Type of utility**	**Company Name**

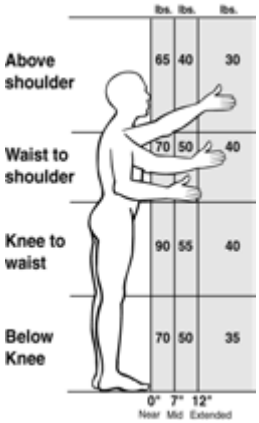
Short description of job duties: Performs regular inspection on water and wastewater lines, manholes, and sewer drain fields; operates power rodder, high velocity jet flusher, video inspection equipment, and vac-all truck. Cleans, flushes and restores these lines to operating condition. Responsible for laying and aligning pipe; installing, repairing or replacing manholes. Operates construction equipment and power tools such as: dump trucks, front-end loaders, backhoes, compressors, jackhammers, sand-blasters, concrete saws, and sewer rodders.

CAUTION ZONE JOB CHECKLIST

Abbreviated Descriptions of Caution Zone Jobs	Can Reach Caution Zone Exposure Level?	Tasks/Activities That Contribute to Caution Level Exposure
1. Hand(s) overhead	NO	
2. Neck bent > 30^{o} or back bent > 30^{o}	NO	
3. Squatting	NO	
4. Kneeling	NO	
5. Pinching > 2 lbs. or > 4 lbs. of force	NO	
6. Gripping > 10 lbs. or > 10 lbs. of force	NO	
7. Highly repetitive motions	NO	
8. Highly intensive keying	NO	
9. Repeated impact (hand or knee)	NO	
10. Heavy lifting	**YES**	Gas generator, 2” concrete grade ring, 6” concrete grade ring, 24” diameter manhole collar, manhole covers, jackhammer
11. Frequent lifting	NO	
12. Awkward lifting	**YES**	Lowering and lifting the camera into/out of the manholes
13. Using high vibration tools	**YES**	Gas powered jack hammer, hydraulic jack hammer, slab saw, chain saw
14. Using moderate vibration tools	NO	

Each company can use these results as a useful comparison, but will need to determine if their own employees have similar exposures. The results of this assessment reflects the job at this particular utility. These results may not be true for the same job title at a different utility.

HAZARD LEVEL ASSESSMENT



A. Lifting Hazard(s): Yes—see all "YES" listings in table

Table itemizes all lifts that called for the hazard level of assessment

NOTE: If the same item is lifted from different positions, two or more hand zone numbers appear in the Hand Zone cell (e.g., lifting from ground level and lifting off the truck bed).

Item Lifted	Weight (in lbs.)	Frequency Factor	Twist Factor	Hand Zone(s) *(Use number from lifting calculator picture)*	Is it a Hazard?
1. Gas generator	90	1	1	70	YES
2. 2" concrete grade ring	78	1	.85	90	YES
				70	YES
3. 6" concrete grade ring	234	1	.85	90	YES
				70	YES
4. 24" diameter manhole collar	178	1	.85	90	YES
				70	YES
5. 24 inch 16 hole manhole cover (use 2/3 of actual weight in lifting calculator)	110	1	1	90	NO
				70	YES
6. 24 inch 2 hole manhole cover (use 2/3 of actual weight in lifting calculator)	155	1	1	90	YES
				70	YES
7. Video camera	45	1	.85	70	NO
8. Jackhammer* -on/off truck	89	1	1	90	NO
9. Jackhammer* -during use	89	0.3	1	90	YES
10. Jackhammer* -on/off truck	60	1	1	90	NO
11. Jackhammer* -during use	60	0.3	1	90	YES

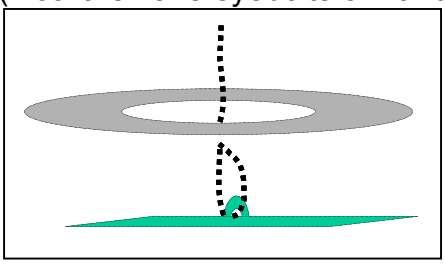
*jackhammer weight includes the tip or chisel

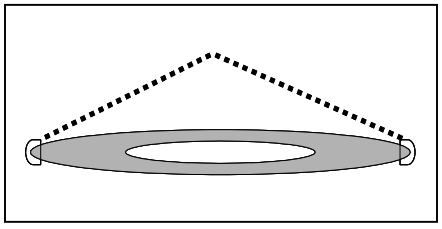
HAZARD REDUCTION EXAMPLES FOR LIFTING:

⇒ **Gas generator (item 1):** Recommendation: Use two people to lift the gas generator.

⇒ **2" and 6" concrete grade ring (items 2 and 3):** Recommendation: Use 2 people to lift the 2" concrete grade rings. For the 6" concrete ring—purchase concrete rings that come with eyebolts attached. Use an excavator or backhoe with a chain through the eyebolts to hoist the ring. Commercially available concrete housing lifters can also be used with an excavator or backhoe to lift and place heavy concrete rings.

⇒ **24" diameter manhole collar (item 4):** Recommendation: Use a mechanical assist such as an excavator or backhoe with a chain to hoist the manhole collar. Chains can be rigged with a lifting plate/bar or with handles (if collars have eyebolts or handles attached).





There are commercially available devices made for lifting and placing manhole collars.

⇒ **110 lb. and 155 lb. manhole cover (items 5 and 6):** Recommendation: See section on acceptable methods for lifting manhole covers. Another way that an employer (City of Vancouver) addressed this problem was to develop a tool. Crewmembers designed and developed their own tool that changes the method from a lift to a pushing down of a lever. Off-the-shelf tools that utilize this principle are available, however, they are generally limited to loads up to 250 lbs.

⇒ **Lifting jackhammers (items 9 and 11):** Lifting the 89 lb. jackhammer out of the truck is not a WMSD hazard but would be if the combined jackhammer and chisel weight exceeds 90 lbs. Commonly, a worker tips the jackhammer from ground level to an upright position. Thus, the lifting weight from ground level is at maximum ½ of the total weight of the jackhammer. Once in the upright position, the worker lifts the jackhammer by the handles from about waist height. Tipping the jackhammer up from the ground is not a lifting hazard. However, a WMSD hazard exists with frequent lifting of the heavy tool during normal operation of a jackhammer. See discussion section for further details.

Recommendations: 1) Use a machine mounted hydraulic pavement breaker (on a backhoe, excavator, etc.) whenever possible. Doing so eliminates heavy lifts and hand-arm vibration exposure related to jackhammer use.
2) Use a walk-behind concrete saw to score and cut the designated area instead of using a jackhammer. Positioning this device does not involve lifting. 3) Use two people when lifting jackhammers that weigh more than 90 lbs. during equipment loading and unloading.

The following recommendations reduce lifting exposures but do not reduce exposures below the hazard level. 4) If manual jackhammering must be done, limit its use to less than 1 hr. per day and use job rotation to keep exposures below this level. 5) If a jackhammer must be used, store the jackhammer in easy to reach locations such as in a holster mounted at an angle on the compressor; storing it in an external cabinet with a low floor and a swing away door so that that it does not have to be lifted over an obstruction; or use a hinge-mounted rod or a bracket that allows the jackhammer to be tilted between horizontal to vertical positions for better positioning while loading or unloading.

Courtesy of Ira Janowitz
UC San Francisco/Berkeley
Ergonomics Program

(CONTINUE TO NEXT PAGE)

Discussion

Jackhammer Operation – Frequent Lifting of Heavy Jackhammers

Utility industry assumptions:
1. Workers use jackhammers for less than 1 hr. per day
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Situations remain where manual 60 lb. and 90 lb. jackhammers must be used. The maximum acceptable lifting weight is 27 lbs for the given parameters of less than 1 hr. per day, 10+ lifts per minute, and hand location close to the body between knee and waist height. This is a hazardous exposure for either jackhammer. This is still true even if the lift frequency is 8-9 per minute.

Possible options:

- Explore the feasibility of using a small walk-behind mechanical device with a hydraulic breaker attachment. Consider renting a walk-behind device with a hydraulic breaker attachment on a trial basis to determine if this is an appropriate alternative to a manual jackhammer.

- Explore the feasibility of using a rock drill combined with a hydraulic splitter as an alternative to a manual jackhammer. The method involves drilling a series of holes along the desired cracking line and placing a splitter tool in the hole. Subsequently, the pressure build-up causes the concrete or asphalt to split along the series of holes.

- A prototype of a jackhammer lift-assist device has been made. Currently, field tests are being conducted on it as part of a gas utility funded project (NYGAS Millennium Project M-2001-011). This is the second-generation prototype. The device is designed to push the embedded jackhammer chisel out of the concrete using an actuator. The operator mainly uses his/her hands to guide and stabilize the jackhammer rather than lift the tool, as before. The primary reason the device was designed was to reduce the force required to unseat a stuck jackhammer chisel. Coincidentally it will also address the frequent lifting problem that leads to the WMSD hazard. (NOTE: The combined weight of the jackhammer plus the device makes it heavier, however, the operator is no longer required to lift the jackhammer to reposition it during normal operation. Workers will still need to lift the jackhammer while loading it on/off the truck). The device is not available commercially at this time. Should this

lift-assist device become available in the future, it may effectively reduce the lifting exposure to below the hazard level. (The device was designed by Stu Senator of Dunton Design Associates, Inc.: http//dunton.senator.net)

- A third generation prototype, "RAPTOR III", was developed to break up pavement quietly and efficiently (Department of Energy and Brookhaven National Laboratory). The device uses a helium driven gas gun to fire a series of nails into the pavement/concrete. Raptor III is bulky and slower than a jackhammer. It would require further improvements before it could become a viable alternative. This device is not available commercially at this time.

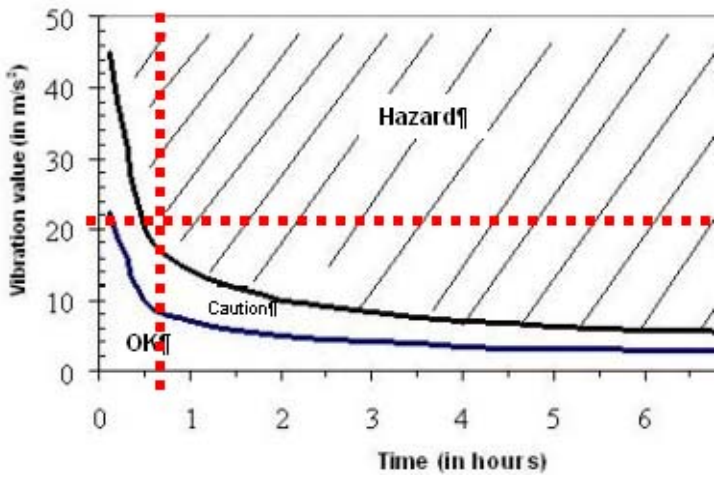
While current practices will continue to be used, employers using this type of equipment should periodically review the availability of feasible alternatives that will reduce the lifting hazards associated with these tools.

B. Hand-Arm Vibration Hazard: Yes—see "YES" listing in table

Hazard determination is based on the vibration level of each specific tool (make and model) and the length of time the tool is used. Those numbers are plotted as coordinates into the Hand-Arm Vibration graph (Appendix B of the WA Ergonomics Rule) to determine if a vibration hazard exists. If the vibration level is not available for a tool, a hazard cannot be determined.

Vibrating Hand Tool	Make/Model #	Vibration Level	Duration	Is it a Hazard?
Jack hammer -gas powered- 60 lb.	Berema (Atlas Copco) FB60	10 m/s^2	≤40 min.	NO
Jack hammer -hydraulic- 89 lb.	Stanley BR89	21.5 m/s^2	≤40 min.	**YES** - depends on duration
Slab saw	Stihl TS400	7.6 m/s^2	<40 min.	NO
Slab saw	Homelite 98D	Unknown	≤40 min.	Unable to determine
Chain saw	Stihl MS310	7.5 m/s^2	≤40 min.	NO

There is a hand-arm vibration hazard if a worker uses the Stanley BR89 hydraulic jackhammer for 40 minutes as indicated in the graph. A hazard cannot be determined for one of the slab saws because the vibration level is not available.



Appendix 1 and Appendix 2 are provided as general guidance references listing field vibration measurements and manufacturers' declared vibration values for some demolition tools. Some reduced vibration jackhammers are listed in Appendix 2.

HAZARD REDUCTION EXAMPLES FOR HAND-ARM VIBRATION EXPOSURE:

⇒ **Hydraulic jackhammer with a vibration level of 21.5 m/s^2:** Recommendations: Use the jackhammer for a shorter duration (<27 minutes) to reduce the exposure below the hazard level. This could be achieved by using job rotation to reduce the single-person exposure duration. Another way to reduce the hazard is to use a jackhammer with a lower vibration level or substitute the tool with alternative equipment with suitably less vibration.

This employer is responsible for:

- Ergonomics awareness education for waste water crew members and their supervisors
- Annual review of caution zone jobs
- Annual review of jackhammer lifting hazard--revisiting feasible alternatives to reduce the hazardous lifting exposures to below the hazard level.

Employees must be involved in hazard assessment and when selecting measures to reduce WMSD hazards.

Other employers may use results of this maintenance worker job assessment as a useful comparison, but will need to determine if their own employees have similar exposures. For example, if a worker for a different employer performs additional duties that contribute to the exposure but are not accounted for in the list of contributing exposure task/activities provided in this assessment, that employer needs to do its own analysis.

APPENDIX 1
Field Vibration Measurements

The following table comes from a report, "GEN 503: The Measurement of Vibration Characteristics of Mining Equipment and Impact Percussive Machines and Tools" (van Niekerk, et al, 1999).
See http://www.simrac.co.za/report/Reports/thrust7/gen503/gen503.htm for project summary or full report.

Vibration Levels of Commonly Used Hand-held Equipment in the South African Mining Industry		
Type of Equipment	**Average Maximum Weighted Acceleration Level and Direction**	**Standard Deviation of the Weighted Acceleration Level**
Pneumatic rock drills	24 m/s^2 (z)	14 m/s^2
Hydraulic rock drills	24 m/s^2 (z)	4.2 m/s^2
Pavement breakers and jackhammers	**19 m/s^2 (z)**	**4.4 m/s^2**
Pneumatic grinders	1.3 m/s^2 (x)	-
Electric hammer drills	8.8 m/s^2 (y)	-
Pneumatic wrench	10 m/s^2 (y)	-
Drill sharpening machine	2.5 m/s^2 (x)	-
Drill re-collaring machine	5.1 m/s^2 (y)	-
Hand-held compactor	13 m/s^2 (z)	-

Data was analyzed according to ISO 5349 first edition - 1986-05-15

Field measurements taken from a 2002 NIOSH Health Hazard Evaluation Report: HETA #2001-0073-2869
Based on ISO 5349 and ANSI S3.34 (this is likely to be a typo and should instead be 19.4)

Table 3. Vibration evaluation of paving breakers and jackhammers

Tool	Test Conditions	Wt. RMS Acc. (m/s²)		Max. Exp. Time (h/d)		Dy (years)
		Dom. Axis	Sum	ANSI*	ACGIH**	(Assum. 30
Sullair paving breaker, MPB-60AF (flexible handle), with flatend chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement	15.6	1.94	1	(over limit)	6.0
Sullair paving breaker, MPB-60AF (flexible handle), with point-end chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement	11.3	13.8	1-2	<1	8.4
Sewer's Sullair paving breaker, MPB-60AF (flexible handle), #9029005 with flat-end chisel	Good quality concrete blocks at a simulated working site	15.5	18.7	1	(over limit)	6.2
Old jackhammer, THOR, #86561, 60 lbs, wide chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement (Worker 1)	49.3	83.7	(over limit)	(over limit)	1.3
Old jackhammer, THOR, #86561, 60 lbs, wide chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement (Worker 1)	45.7	78.8	(over limit)	(over limit)	1.3
Old jackhammer, THOR, #86561, 60 lbs, narrow chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement (Worker 2)	50.6	86.4	(over limit)	(over limit)	1.2
Old jackhammer, THOR #86561, 60 lbs, narrow chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement (Worker 2)	37.9	62.7	(over limit)	(over limit)	1.7
Old jackhammer, KENT, #9590, 90 lbs, wide chisel	Good quality concrete with steel reinforcement, on a bridge sidewalk pavement	37.5	55	(over limit)	(over limit)	2.0
Old jackhammer, #CP1240, 60 lbs, narrow chisel	3" asphalt on 8" concrete pavement	22.9	37	(over limit)	(over limit)	3.0

APPENDIX 2

Manufacturers' Declared Vibration Levels for Jackhammers:

Brand	Model Number	Weight in lbs.	Vibration level (m/s^2)
Atlas Copco	TEX-14PS	33	14.0
Atlas Copco	TEX-18PS	44	14.0
Atlas Copco	TEX-27PS-118	64	14.0
Atlas Copco	TEX-27PS-125	64	14.0
Atlas Copco	TEX-32PS-118	75	14.0
Atlas Copco	TEX-32PS-125	75	14.0
Atlas Copco	TEX-39PS-118	86	15.0
Atlas Copco	TEX-39PS-125	86	15.0
Atlas Copco	Cobra MK-1	52.9	2.3
Chicago Pneumatic	CP1210 S	54	15-17
Chicago Pneumatic	CP1210 VRS	59	7
Chicago Pneumatic	CP1230 S	68	15-17
Chicago Pneumatic	CP1230 VRS	76	7
Chicago Pneumatic	CP1240 S	86	15-17
Chicago Pneumatic	CP1240 VRS	95	11
Chicago Pneumatic	CP117 S	79	15-17
Ingersoll-Rand	PROMAXX MX60/60S	70	24.6
Ingersoll-Rand	PROMAXX MX60F/60SF	70	19.7
Ingersoll-Rand	PROMAXX MX90/90S	87	23.5
Ingersoll-Rand	PROMAXX MX90F/90SF	87	20.6
Ingersoll-Rand	JX35	32	30.2
Ingersoll-Rand	JX35S	34	30.2
Ingersoll-Rand	IR30VRD	33	2.76
Ingersoll-Rand	IR30VRC	33	2.76
Ingersoll-Rand	IR45VRC	46	4.09
Ingersoll-Rand	IR45VRA	46	4.09
Ingersoll-Rand	IR45VRB	46	4.09
Ingersoll-Rand	IR60VRA	60	4.28
Ingersoll-Rand	IR60VRB	60	4.28
Ingersoll-Rand	IR90VRA	88	7.94
Ingersoll-Rand	IR90VRB	88	7.94
Macdonald Air Tools	VRS2	58	3.4
Racine (hydraulic)	HBR-60LV	60	5.38

Shaded cells indicate lower vibration level tools

APPENDIX 2

Manufacturers' Declared Vibration Levels for Jackhammers (continued)**:**

Brand	Model Number	Weight in lbs.	Vibration level (m/s^2)
Stanley (hydraulic)	BR87		21.5
Stanley (hydraulic)	BR89		21.5

Rock Drills

Manufacturers' Declared Vibration Levels for Rock Drills

Brand	Model Number	Weight in lbs.	Vibration level (m/s^2)
Chicago Pneumatic	**CP0009**	9	12
Chicago Pneumatic	**CP0014RR**	15	14
Chicago Pneumatic	**CP0022**	28	22
Chicago Pneumatic	**CP0032A**	55	22
Chicago Pneumatic	**CP0069**	60	22